(12) UK Patent (19) GB (11) 2 292 653 (13) B

(54) Title of Invention

Adaptable radio telephone handset

(51) INT CL[6]; **H04Q 7/32**

(21) Application No
9515342.5

(22) Date of filing
26.07.1995

(30) Priority Data

(31) **08295562**

(32) **25.08.1994**

(33) **US**

(43) Application published
28.02.1996

(45) Patent published
13.01.1999

(52) Domestic classification
(Edition Q)
H4L LDSC LECC L1H10 L1H3

(56) Documents cited
GB2268362 A
EP0521609 A2
EP0503151 A2
US5396653 A

(58) Field of search

As for published application 2292653 A viz:
UK CL(Edition N) **H4L LDSC LECC**
INT CL[6] **H04Q 7/32**
Online: WPI
updated as appropriate

(72) Inventor(s)
Richard D Poole

(73) Proprietor(s)
Motorola Inc

(Incorporated in USA - Delaware)

Corporate Offices
1303 East Algonquin Road
Schaumburg
Illinois 60196
United States of America

(74) Agent and/or
Address for Service
Hugh Dunlop
Motorola Limited
European Intellectual Property Operation
Midpoint
Alencon Link
Basingstoke
Hampshire
RG21 7PL
United Kingdom

FIG.1

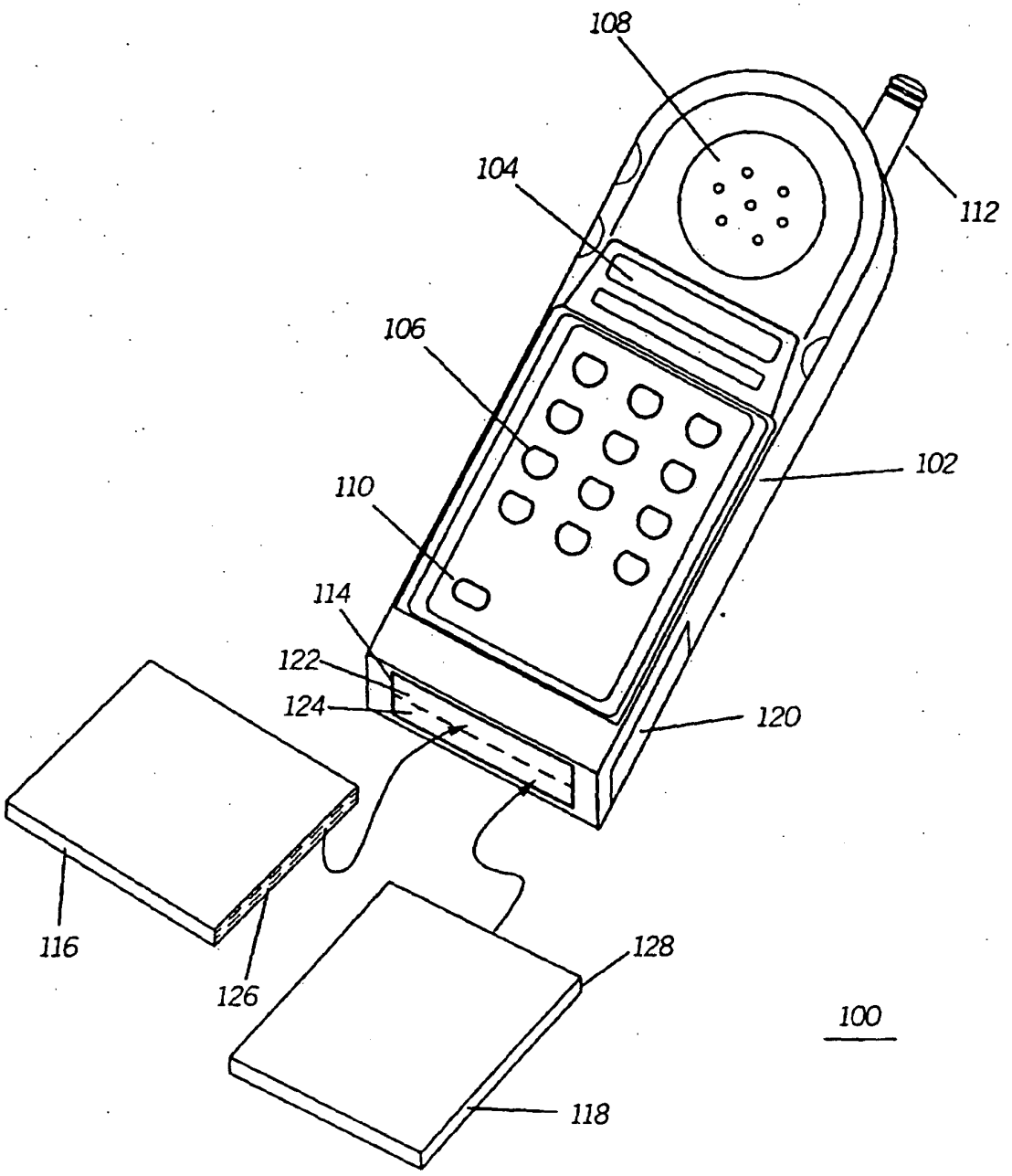


FIG.2

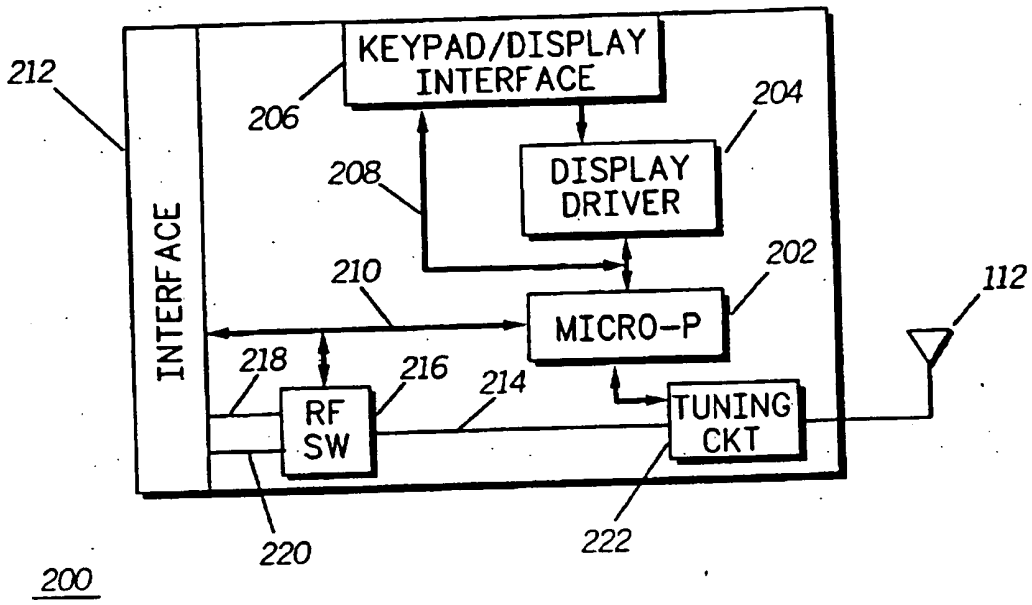
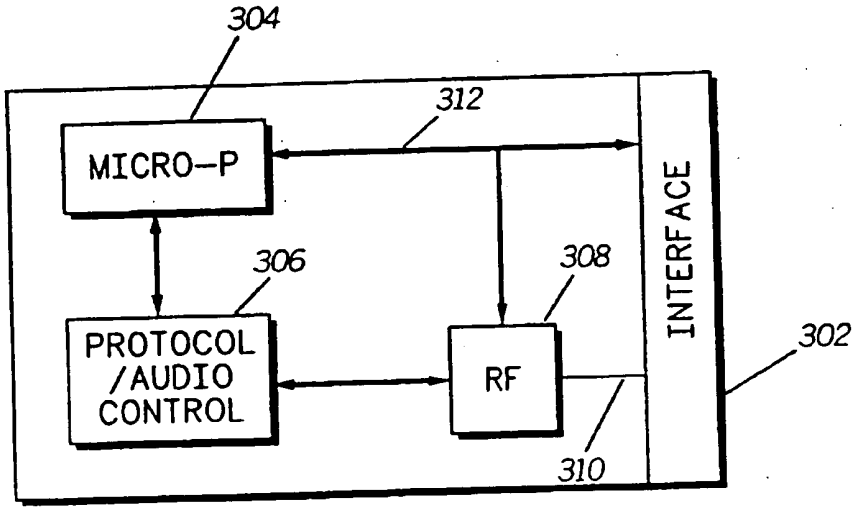

212
INTERFACE
KEYPAD/DISPLAY INTERFACE
206
204
DISPLAY DRIVER
208
202
210
MICRO-P
112
218
216
214
RF SW
TUNING CKT
220
222
200

FIG.3


304
312
MICRO-P
306
308
PROTOCOL /AUDIO CONTROL
RF
INTERFACE
302
310
300

2292653

ADAPTABLE RADIO TELEPHONE HANDSET

Technical Field

This invention relates to communication devices, and more specifically to portable communication devices.

Background

With the ever increasing popularity of personal communication devices, such as cordless telephone and cellular telephone handsets, a higher priority is being placed upon designing these devices in lightweight and compact forms that are readily portable. While a user may enjoy the portability of these devices, he may still require carrying several devices at the same time in order to have two-way voice communication in different geographic locations that use different communication protocol systems. Having to carry separate handsets for independent protocol systems, each having a separate user interface, can become cumbersome for the user. Furthermore, these devices typically require separate accessories, such as chargers, battery packs, and carrying cases, which create additional inconvenience for the user when mobile. The alternate choice for a potential user is to lock into a specific protocol system package which may not fit all of his requirements. Likewise, when a user upgrades to a new system, he has to re-program the new phone with his commonly used phone numbers and learn a new interface (i.e., how to operate the new phone).

Current implementations of cellular and the planned implementations of Personal Communication Systems (PCS) portable telephones have been either single protocol or dual-mode protocol, however both protocols are hard encoded into the telephone handset.

Subscriber Information Module (SIM) cards for Global System for Mobile communications (GSM), a European protocol system, currently provide subscriber information (e.g. subscriber phone number, service provider) and plug into a GSM phone to configure the phone for that

subscriber. However, these cards only reference the subscriber data and do not include radio frequency (RF) circuitry or protocol information.

Hence, there is a need for a single portable communication device that can incorporate multiple communication protocols and provide a common user interface.

Summary of the Invention

Accordingly, in a first aspect, the invention provides a communication device, characterized by a first removable module providing a primary communication protocol for accessing a first communication system, the first removable module including a first protocol control circuit for providing the primary communication protocol and a first receiver and transmitter circuit for receiving and transmitting radio frequency (RF) signals at a first frequency; a second removable module automatically enabled whenever the first removable module is not accessing the first communication system and providing a secondary communication protocol for accessing a second communication system, the second removable module including a second protocol control circuit for providing the secondary communication protocol and a second receiver and transmitter circuit for receiving and transmitting RF signals at a second frequency; and a common user interface means for programming user specific information into the communication device and providing a common user interface for the primary and secondary communication protocols, the common user interface means including an antenna circuit having an antenna and an impedance matching circuit coupled between the antenna and the first receiver and transmitter circuit and the second receiver and transmitter circuit.

Accordingly, in a second aspect, the invention provides a communication device, characterized by: a handset including: a user interface; a common board for controlling operation of the communication device, the common board including a module interface, a microprocessor and a radio frequency (RF) switch coupled to the module interface, the RF switch having a control input coupled to the microprocessor; a housing

containing the user interface and the common board, the housing having an aperture providing access to the module interface; a first module configured for insertion in the aperture, the first module including a first control circuit and a first RF section, the first module further including a first module mating interface configured for electrically coupling the first control circuit and the first RF section to the module interface with appropriate impedance when the first module is inserted in the aperture, the first control circuit and the first RF section cooperating with the common board for operating the communication device according to a first communication protocol; a second module configured for insertion in the aperture, the second module including a second control circuit and a second RF section, the second module further including a second module mating interface configured for electrically coupling the second control circuit and the second RF section to the module interface with appropriate impedance, the second control circuit and the second RF section cooperating with the common board for operating the communication device according to a second communication protocol; and an antenna coupled to the RF switch, the RF switch selectively coupling one of the first module mating interface and the second module mating interface to the antenna in response to a control signal received from the microprocessor.

Brief Description of the Drawings

FIG. 1 is a drawing illustrating a portable communication device in accordance with the present invention.

FIG. 2 is an electrical block diagram of the internal electronics associated with the portable communication device in accordance with the present invention.

FIG. 3 is an electrical block diagram of a module in accordance with the present invention.

Detailed Description of the Preferred Embodiment

Referring now to FIG. 1 there is shown a portable communication device, or adaptable radio telephone handset, 100 in accordance with the present invention. Included in the handset 100 are housing 102, display 104, keypad 106, speaker 108, microphone 110, and antenna 112. Insertable/removable modules 116 and 118, each containing radio controller and radio frequency (RF) functions related to separate communication protocol systems, are shown external to the handset 100. These modules 116, 118 can be inserted into the handset 100 through aperture 114 to mate up with electronic circuitry (to be described later) within the housing 102. Interconnects 126, 128, located within each module 116, 118, provide electrical interconnect to mate up with the internal circuitry of the handset 100. When more than one module is inserted into the handset 100, a primary slot 122, and secondary slot 124 are defined within the handset 100. In FIG. 1, the primary slot 122 is being used to accommodate module 116 while the secondary slot 124 accommodates the second module 118, however these modules could be interchanged to the opposite slot if desired.

Each module 116, 118 contains protocol specific hardware and software related to the protocol it was designed for. Once inserted into the handset 100, the modules 116, 118 provide independent communication protocols with which to access separate communication systems. The handset 100 can be programmed for single or multiple identification numbers. The handset 100 provides a common user interface through the keypad 106 and display 104 regardless of the communication protocol being used. User specific information, such as frequently dialed numbers/names and lock codes, can be programmed into the handset 100 by the user. This user specific information can be programmed into the handset regardless of whether or not a module is inserted. Battery compartment 120 supplies power to the internal electrical circuits of the handset 100 as well as those of the modules 116, 118. All of the modules and internal circuitry operate at preferably 3.0V DC. Thus, a common battery charger and common battery pack can be used regardless of the protocol to which the handset 100 is configured.

As an example of user operation, the user can program the handset 100 with user specific information, such as lock codes and frequently dialed numbers, without any modules inserted. The user then inserts a module, such as a 1900 megahertz (MHz) Personal Access Communication Systems (PACS)-Time Division Multiple Access (TDMA) module, into the primary slot 122. A second module, such as an 800 MHz Advanced Mobile Phone System (AMPS) module, can be inserted into the secondary slot 124. The user specific information is automatically downloaded or otherwise made available to both modules. The handset initially establishes communication using the primary slot, in this case the 1900MHz PACS-TDMA system. The secondary slot 124 becomes automatically available to take over when the primary system is not functioning, for example if the handset is out of range of the primary system. Alternatively, the user can use a keypad command to change from one communication protocol to another in order to establish a communication link.

The modules 116, 118 are all standardized to a common size designed to fit into the slots 122, 124 of the handset 100. If the user moves to an area that employs entirely different protocol systems, he can manually change out the module(s) to accommodate another module or set of modules. For example a 1900MHz Code Division Multiple Access

(CDMA) module could be inserted and used as the primary module and a 800MHz TDMA module could be inserted and used as the secondary module. Multiple modules can be carried by the user to provide access to multiple communication systems wherever he goes. When the presently inserted module(s) do not cover a particular area, the user need simply change the module(s) when wanting to change protocols. By utilizing the adaptable radio telephone handset as described by the invention, the user may keep one communication device with one user interface as opposed to multiple handsets.

Referring now to FIG. 2 of the accompanying drawings there is shown an electrical block diagram of the internal circuitry associated with the handset in accordance with the present invention. Circuitry 200 is preferably included on a printed circuit board referred to as the common board and comprises a controller means including microprocessor 202 having associated memory and peripherals and a display driver 204. Bus lines 208 control the communication between the microprocessor 202 and the display driver 204 and also goes to a keypad/display interface 206, such as a flexible interconnect (flex). The keypad/display interface 206 provides the interconnect between the keypad 106 of the handset 100 and the microprocessor 202 as well as the display 104 and the display driver 204. The user can program the handset 100 with user specific information via the keypad 106 and have it stored in microprocessor 202. This type of user specific information is stored and made available to any enabled module inserted within the handset 100.

Also included in the common board 200, is a module interface 212 that provides a standardized interconnect for receiving the modules 116, 118. Bus lines 210 download the programmed user specific information from the microprocessor 202 to the modules 116, 118 once inserted. Information regarding the communication status of the inserted modules 116, 118 is also sent via bus lines 210 to the microprocessor 202 so that the microprocessor can control the switching between the two modules 116, 118. The microprocessor 202 preferably keeps one module in a sleep mode while the other module is engaged in a communication link in order to conserve current drain.

The module interface 212 is preferably a dual head multi-contact, or multi-pin, connector designed to mate up to corresponding interconnects

126, 128 of the modules 116, 118 and provide electrical contact between the common board 200 and the inserted modules. Included in the connector are preferably two RF contacts that provide RF connections for the modules 116 and 118 with appropriate impedance. These RF contacts are preferably brought out to separate RF paths 218, 220 on the common board 200, such that each path is associated with a different module. RF paths 218, 220 are preferably coupled to an RF switch 216 under the control of microprocessor 202. The RF switch 216 switches in the RF path of the currently enabled module to an RF trace 214. Thus, only one RF path makes electrical interconnect to the RF trace 214 of the handset 100. The RF trace 214 interconnects to a tuning circuit 222, preferably under microprocessor control 202, that automatically controls the tuning of the antenna 112 to the appropriate frequency with appropriate matched impedance.

Referring now to FIG. 3 of the accompanying drawings there is shown an electrical block diagram 300 of the circuitry associated with one of the modules 116. A similar diagram would apply to the second module 118. Included in the module circuitry 300 is module interface 302 which includes corresponding mating contacts for providing the interconnect between the module and the interface 212 of the circuit 200. A microprocessor 304 along with protocol/audio control circuitry 306 provide all of the protocol specific controls for a specific communication system. Control lines 312 transfer user specific information generated from the common board 200 to the microprocessor 304 as well as provide other controller functions to the rest of the module circuitry 300. Included in the module circuitry 300 is RF section 308 which further includes transmitter and receiver circuitry specific to the particular communication system and providing RF path 310 to the module interface 302.

Module interface 302 includes an RF interconnect for the RF path 310 of the module. The module interface 302 includes an RF contact capable of relaying an RF signal with appropriate impedance matching through to the corresponding mating contact in the module interface 212 and on to its corresponding RF path 218 of the common board 200. The second module 118 includes a similar circuit for another specific protocol that can be inserted into the interface 212 and, when enabled, similarly

provide its RF path to the corresponding RF path 220 of common board 200.

By employing the adaptable radio telephone handset as described by the invention, users are able to retain the same user control interface as well as the custom programming they defined for the operation of their handset. By incorporating different modules within the handset, a user is provided with access to multiple protocols and systems. Other types of communication protocols that could be implemented include, but are not limited to, 1900MHz Digital Cordless Telephone U. S. (DCTU), 900MHz Total Access Communication System (TACS), and 1900MHz Digital European Cordless Telephone (DECT). While the preferred embodiment describes two modules inserted into the handset, one of reasonable skill in the art would be able to apply this invention to a handset designed to accommodate a larger number of modules. Common accessories, such as a carrying case, battery packs, and battery charger, can be used with the handset as described by the invention, this adds up to a significant cost saving to the end user.

While the preferred embodiments of the invention have been illustrated and described, it will be clear that the invention is not so limited. Numerous modifications, changes, variations, substitutions, and equivalents will occur to those skilled in the art without departing from the spirit and scope of the present invention as defined by the appended claims.

What is claimed is:

1. A communication device, characterized by:

a first removable module providing a primary communication protocol for accessing a first communication system, the first removable module including a first protocol control circuit for providing the primary communication protocol and a first receiver and transmitter circuit for receiving and transmitting radio frequency (RF) signals at a first frequency;

a second removable module automatically enabled whenever the first removable module is not accessing the first communication system and providing a secondary communication protocol for accessing a second communication system, the second removable module including a second protocol control circuit for providing the secondary communication protocol and a second receiver and transmitter circuit for receiving and transmitting RF signals at a second frequency; and

a common user interface means for programming user specific information into the communication device and providing a common user interface for the primary and secondary communication protocols, the common user interface means including an antenna circuit having an antenna and an impedance matching circuit coupled between the antenna and the first receiver and transmitter circuit and the second receiver and transmitter circuit.

2. A communication device as described in claim 1, wherein the first removable module is replaceable by a third removable module for accessing a third communication system using a third communication protocol.

3. A communication device, characterized by:

a handset including:

a user interface;

a common board for controlling operation of the communication device, the common board including a module interface, a microprocessor and a radio frequency (RF) switch coupled to the module interface, the RF switch having a control input coupled to the microprocessor;

a housing containing the user interface and the common board, the housing having an aperture providing access to the module interface;

a first module configured for insertion in the aperture, the first module including a first control circuit and a first RF section, the first module further including a first module mating interface configured for electrically coupling the first control circuit and the first RF section to the module interface with appropriate impedance when the first module is inserted in the aperture, the first control circuit and the first RF section cooperating with the common board for operating the communication device according to a first communication protocol;

a second module configured for insertion in the aperture, the second module including a second control circuit and a second RF section, the second module further including a second module mating interface configured for electrically coupling the second control circuit and the second RF section to the module interface with appropriate impedance, the second control circuit and the second RF section cooperating with the common board for operating the communication device according to a second communication protocol; and

an antenna coupled to the RF switch, the RF switch selectively coupling one of the first module mating interface and the second module mating interface to the antenna in response to a control signal received from the microprocessor.

4. A communication device as recited in claim 3 wherein the first control circuit comprises a first microprocessor and first protocol/audio control circuitry and wherein the second control circuit comprises a second microprocessor and second protocol/audio control circuitry.

5. A communication device as recited in claim 4 wherein the first module further includes a first RF path coupled between the first RF section and the first module mating interface, and wherein the second module includes a second RF path coupled between the second RF section and the second module mating interface, and wherein the common board includes a first switched RF path and a second switched RF path coupled between the module interface and the RF switch, and wherein the first RF path electrically couples to the first switched RF path when the first module is inserted in the aperture and the second RF path electrically couples to the second switched RF path when the second module is inserted in the aperture, the RF switch coupling one of the first switched RF path and the second switched RF path to the antenna in response to the control signal.

6. A communication device as recited in claim 5 wherein the first RF section includes transmitter and receiver circuitry specific to the first communication protocol and wherein the second RF section includes transmitter and receiver circuitry specific to the second communication protocol.

7. A communication device as recited in claim 5 wherein the module interface comprises a connector including a first RF contact and a second RF contact and wherein the first RF contact couples to the first module mating interface with appropriate impedance, and wherein the second RF contact couples to the second module mating interface with appropriate impedance.

8. A communication device as recited in claim 3 wherein the common board further includes bus lines coupled between the microprocessor and the module interface for electrically coupling the microprocessor with the first module and the second module.

9. A communication device as recited in claim 8 wherein the bus lines are configured for conveying user specific information from the microprocessor to the first module and the second module when the first module and the second module are inserted in the aperture.

10. A communication device as recited in claim 8 wherein the microprocessor keeps one module of the first module and the second module in a sleep mode while the other module of the first module and the second module is engaged in a communication link.

11. A communication device as recited in claim 3 wherein the common board further includes a tuning circuit coupled between the RF switch and the antenna for controlling the tuning of the antenna to the appropriate frequency with appropriate matched impedance.

12. A communication device as recited in claim 11 wherein the tuning circuit includes a control input coupled to the microprocessor for receiving a control signal, the tuning circuit controlling the tuning of the antenna in response to the control signal.

13 .A communication device substantially as hereinbefore described with reference to the drawings.